IN THE CLAIMS:

Claim 1. (Currently Amended) A system employing microoptic elements [[with]] and synthetic birefringence for modifying the transmission characteristics of an input optical beam having multiple wavelengths to provide periodically spaced passbands, comprising first and second polarization beam splitter devices, wherein the first polarization beam splitter device separates the input beam into first and second orthogonally polarized output beams along first and second beam paths, a first non-birefringent optical delay line in the first beam path arranged such that the first beam undergoes a first time delay, a second non-birefringent optical delay line in the second beam path arranged such that the second beam undergoes a second time delay, different from the first, with the time delay difference being precisely determined by optical path length difference between the optical delay lines, and the second polarization beam splitter device being arranged to recombine the first and second delayed beams into a single beam having interfering components defining the desired periodically spaced passbands, and wherein the system further includes half and quarter waveplates disposed in each of the beam paths and positionable at angles tuning the bandpass characteristics of the system. ~~modification in transmission characteristic.~~

Claim 2. (Currently Amended) ~~An element~~ A system in accordance with claim 1, wherein the delay lines are glass elements having substantially like thermal expansion coefficients and selected to provide athermal time delay difference characteristics between the two paths over a selected range of temperature variations. ~~interposed in each beam path and the glass elements are selected to provide athermal time delay difference characteristics between the two paths.~~

Claim 3. (Cancelled)

Claim 4. (Currently Amended) ~~An element~~ A system employing microoptic elements in accordance with claim 1 wherein the optical delay lines comprise first and second glass elements in the first and second beam paths respectively, the first and second glass elements having approximately the same physical length and different optical indices of refraction providing the chosen time delay difference.

Claim 5. (Currently Amended) ~~An element~~ A system in accordance with claim 4 above, wherein the difference in index of refraction is in excess of about 15%, the first glass element has an index of refraction of about 1.5 and the second glass element has an index of refraction of about 1.9.

Claim 6. (Cancelled)

Claim 7. (Currently Amended) ~~An element~~ A system in accordance with claim 1 wherein the lengths of the first and second beam splitters are matched to within 250 microns, wherein the physical lengths of the first and second beam splitters are nominally 6 to 10 mm, and wherein the first and second beam splitters are fabricated from VYO_4 crystalline material.

Claim 8. (Cancelled)

Claim 9. (Cancelled)

Claim 10. (Currently Amended) A microoptic element with synthetic birefringence for modifying the transmission characteristics of an input optical beam comprising first and second polarization beam splitter devices, the first of which separates the input optical beam into orthogonally polarized first and second beams transmitted along separate first and second paths, first and second non-birefringent optical delay lines along

the separate paths, the optical delay lines introducing different time delays having a predetermined time delay difference, the first and second optical delay lines each comprising ~~An element in accordance with claim 1, wherein the element comprises~~ a number of serial stages each providing a time delay difference which is an integer multiple of a selected value, and each stage [[has]] having an athermal response over a selected range of temperatures, the second polarization beam splitter device being arranged to recombine the first and second delayed beams into a single beam having interfering components defining the desired modification in transmission characteristic, and wherein the microoptic element further includes, before the first stage, a half waveplate oriented at 45^0 to the vertical axis, and waveplates disposed in the beam paths between subsequent stages at predetermined angles selected to tune the transmission characteristics to a desired optical transfer function.

Claim 11. (Cancelled)

Claim 12. (Cancelled)

Claim 13 (Currently Amended) ~~An element in accordance with claim 10~~ A microoptic element with synthetic birefringence for modifying the transmission characteristics of an input optical beam comprising first and second polarization beam splitter devices, wherein the first polarization beam splitter device separates the input beam into first and second orthogonally polarized output beams directed along first and second beam paths, a first non-birefringent optical delay line in the first beam path arranged such that the first beam undergoes a first time delay, a second non-birefringent optical delay line in the second beam path arranged such that the second beam undergoes a second time delay, different from the first, with the time delay difference being

precisely determined by the path length difference between the optical delay lines, wherein the element comprises a number of serial stages each providing a time delay difference which is an integer multiple of a selected value, and having an athermal response over a selected range of temperatures, the element further including a phase shifting tuning structure inserted in both the first and second beam paths, said tuning structure further comprising:

a first quarter or three-quarter waveplate oriented at $\pm 45^{\circ}$;

at least one half waveplate whose orientation is rotatable to align the absolute frequency of output transmission peaks to match a target frequency grid, [[and]]

a second quarter or three-quarter waveplate, and

the second polarization beam splitter device being arranged to recombine the first and second delayed beams into a single beam having interfering components defining the desired modification in transmission characteristic.

Claim 14. (Currently amended) An element in accordance with claim [[1]] 13 above wherein said difference in optical path lengths is proportional to $\frac{c}{\Delta f}$, where Δf is the frequency period of the optical transmission response.

Claim15. (Currently amended) An element in accordance with claim [[1]] 13 above, wherein one delay line includes at least two nonbirefringent glass elements in series, wherein the beam paths include air paths between elements, and wherein the difference in air path lengths between the two beams is less than 600 microns.

Claim 16. (Currently amended) An element in accordance with claim [[1]] 13 wherein at least one delay line comprises an airspaced delay line providing a precise amount of optical path length difference between the first and second beam paths.

Claim 17. (Cancelled)

Claim 18. (Currently Amended) ~~An element as set forth in claim 1 above,~~ A microoptic element with synthetic birefringence for modifying the transmission characteristics of an input optical beam comprising first and second beam splitter devices, wherein the first polarization beam splitter device separates the input beam into first and second orthogonally polarized output beams along first and second beam paths, a first non-birefringent optical delay line in the first path arranged such that the first beam undergoes a first time delay, a second non-birefringent optical delay line in the second beam path arranged such that the second beam undergoes a second time delay, different from the first, with the time delay difference being precisely determined by the optical path difference between the optical delay lines, and the second polarization beam splitter device being arranged to recombine the first and second delayed beams into a single beam having interfering components defining the desired modification in transmission characteristics, and wherein the element further comprises in the optical delay lines a number of delay elements in cascading stages, and the stages include means for compensating existing chromatic dispersion comprising means disposed in the elements in the cascaded stages and responsive to polarization of the beams for canceling the dispersion slope and providing substantially constant dispersion.

Claim 19. (Original) An element as set forth in claim 18 above, wherein the means for compensating chromatic dispersion includes means in association with the stages for controlling the polarization vector angles into the stages.

Claim 20 (Currently Amended) ~~An element as set forth in claim 1 above,~~ A microoptic element with synthetic birefringence for modifying the transmission characteristics of an input optical beam comprising first and second polarization beam splitter devices, wherein the first polarization beam splitter device separates the input beam into first and second orthogonally polarized output beams along first and second beam paths, a first non-birefringent optical delay line in the first beam path arranged such that the first beam undergoes a first time delay, a second non-birefringent optical delay line in the second beam path arranged such that the second beam undergoes a second time delay, different from the first, with the time delay difference being precisely determined by optical path length difference between the optical delay lines, and the second polarization beam splitter device being arranged to recombine the first and second delayed beams into a single beam having interfering components defining the desired modification in transmission characteristics, the element also including third, forth and fifth polarization beam splitter elements, the third polarization beam splitter being disposed before the first to split the first input beam into upper and lower orthogonally polarized beam pairs for differential delays, wherein the fourth polarization beam splitter device receives the beam pairs after differential delay to provide two pairs of wavelength dependent intensity modulated beams of orthogonal polarization and the fifth polarization beam splitter device is disposed after the forth polarization beam splitter to combine the power of the pairs of orthogonally polarized, intensity modulated beams.

Claim 21. (Original) An element as set forth in claim 20 above, wherein the element includes wavelength tuning elements in the beam paths associated with the optical delay lines.

Claim 22. (Original) An element as set forth in claim 21 above, wherein the wavelength tuning elements comprise rotatably adjustable waveplates.

Claim 23. (Currently Amended) An element as set forth in claim [[1]] 20 above wherein at least one polarization beam splitter is angled relative to the input beam to adjust frequency period.

Claim 24. (Original) A system for dividing a number of signals periodically spaced in optical frequency propagating on an input waveguide into two sets of signals each having twice the periodic frequency spacing, with the frequencies in the two sets being in alternating relation, comprising:

an input polarization beam splitter coupled to receive the input optical frequencies, the input polarization splitter providing two differently polarized beams as outputs;

a second polarization beam splitter disposed to split each polarized beam into a pair of adjacent beams of orthogonal polarization;

a differential delay stage of two parallel optical delay paths each having at least one non-birefringent optical delay element, the indices of refraction and the lengths of the delay elements in each of the paths being chosen such that the optical signals of different polarizations are differentially retarded in the two pairs of beams by selected amounts relative to the desired periodic spacings;

a polarization combiner receiving the delayed signals from the two paths of the delay stage for combining beams to produce periodic, wavelength dependent states of polarization of selected optical frequency and phase, and

an output polarization combiner responsive to products of the combined beams for recombining beams of different polarizations into two separate intensity modulated outputs, each providing one different frequency set.

Claim 25. (Original) A system as set forth in claim 24 above, wherein at least one delay element is glass.

Claim 26. (Original) A system as set forth in claim 24 above, wherein the system provides passbands of selected frequencies in accordance with a selected ITU grid and the optical delay elements and the delay stage includes air length segments in each path, with the optical delay elements and air length segments in each path being interrelated to provide an athermal response to temperature variations over a selected range.

Claim 27. (Original) A system as set forth in claim 24 above, wherein the differential delay stage comprises delay elements of non-birefringent glass of different indices of refraction.

Claim 28. (Original) A system as set forth in claim 24 above, wherein the differential delay stage comprises a pair of glass elements serially disposed in one path and a single glass element disposed in the other.

Claim 29. (Original) A system as set forth in claim 24 above, wherein the input beam splitting polarizer divides the input into extraordinary and ordinary polarization beams

for the two optical paths, and wherein the differential delay stage comprises polarization vector control means for phase tuning the transmission characteristics of the stage.

Claim 30. (Original) A system as set forth in claim 24 above, wherein at least one of the polarization beam splitters is angled relative to the beam direction to adjust the frequency period of the outputs.

Claim 31. (Original) A system as set forth in claim 24 above, wherein at least one of the differential delay stages includes an air delay line element.

Claim 32. (Original) A system as set forth in claim 31 above, wherein the differential delay stage comprises a first path having a non-birefringent glass element and a second path having a closed loop of reflecting elements providing a complete circuit of selected optical path length.

Claim 33. (Currently Amended) A system as set forth in claim 24 above, wherein the system further includes, in each beam path, in association [[to]] with the differential delay stage, elements imparting circular polarization to the beams, waveplate frequency adjusting means receiving the circularly polarized signals, and polarizing means receiving the frequency adjusted signals.

Claim 34. (Currently Amended) A microoptic element providing synthetic birefringence to applying a filtering function to an optical input beam, comprising:

an input polarization beam splitter means receiving the optical input beam and providing as outputs two differently polarized beams;

two signal delay paths, each comprising at least one non-birefringent optical element and receiving a different one of the differently polarized beams, the said non-birefringent elements having different selected indices of refraction,

wherein the indices are different by more than 15%, wherein the non-birefringent elements are of glass and of substantially equal lengths accurate within ±1 micron of calculated lengths such that a precise relative retardation for the desired filtering function that is introduced, and

an output polarization beam splitter receiving both beams and combining them.

Claim 35. (Cancelled)

Claim 36. (Currently Amended) A microoptic element as set forth in claim [[35]] 34 above, wherein the optical delays provide selected periodic bandpass functions in the optical input signals, and wherein the periodicity of the bandpass functions align the bandpass regions with respect to ITU grid standards.

Claim 37. (Original) A microoptic element as set forth in claim 36 above, wherein the indices of refraction are chosen such that the element has differential optical paths varying to less than 1 part in 10^4 relative to a selected ITU grid periodicity, and the individual elements are of less than 20 mm in length.

Claim 38. (Original) A microoptic element as set forth in claim 37 above, wherein the signal delay paths comprise several stages each having at least one glass element, the first stage elements having a length L and disposed in a series of n elements, where n is an integer of 1 or greater, and succeeding stages having total lengths that are integer multiples of nL in length.

Claim 39. (Original) A microoptic element as set forth in claim 38 above, wherein the stages each include different glass elements selected to provide a passive athermal characteristic over a selected temperature range in each stage.

Claim 40. (Original) A microoptic element as set forth in claim 39 above, wherein the stages further include waveplate tuning elements for adjusting the periodicities of the outputs precisely to the ITU grid and the glass elements are 8-16 mm in length and the microoptic element is less than about 15 cm in total length.

Claim 41. (Original) A microoptic element as set forth in claim 40 above, wherein the output beam splitter comprises a first output beam splitter oriented to split each optical signal into two orthogonally polarized beams and a second output beam splitter orthogonally positioned relative to the first output beam splitter to recombine optical beam sets to polarization insensitive outputs.

Claim 42. (Currently Amended) A system for introducing a periodic transmissive function to an input optical beam of an arbitrary state of polarization having wavelength multiplexed channels comprising:

at least a first beam splitter arrangement receiving the optical beam and providing two beam pairs of different polarizations;

a pair of polarization insensitive optical delay lines, each in the path of a different beam, and introducing selected differential optical delays between beam pairs to provide wavelength dependent, polarization modulated beams carrying the multiplexed channels; and

at least a second beam splitter arrangement receiving the different beams from the delay lines and combining them to form [[a]] wavelength dependent, polarization modulated beams which transmit multiplexed channels of different spacings than the input.

Claim 43. (Original) A system as set forth in claim 42 above, wherein the optical delay lines comprise non-birefringent elements of substantially like physical lengths and different indices of refraction.

Claim 44. (Original) A system as set forth in claim 42 above, wherein the optical delay lines in the different paths are glass elements selected to have like optical path length changes with temperature.

Claim 45. (Original) A system as set forth in claim 44 above, wherein the glass elements are of lengths and refractive indices selected to compensate for thermal expansion and thermooptic effects along the two beam paths.

Claim 46. (Original) A system as set forth in claim 42 above, wherein the optical delay lines are arranged in at least two stages with integer related optical delay differential characteristics whose total differential optical lengths vary by integral multiples such that transmission passbands are shaped to selected characteristics.

Claim 47. (Original) A system as set forth in claim 42 above, wherein the system comprises in addition at least one additional stage of a pair of polarization insensitive optical delay lines in series with the first pair, input polarization management optics associated with the first beam splitter arrangement for launching a pair of identically polarized beams into the first optical delay line pair, and output polarization management optics associated with the second beam splitter arrangement for separating an identically polarized beam pair into alternate channels and combining them to provide polarization independent outputs.

Claim 48. (Original) A multistage optical signal interleaver providing periodically spaced passbands to one or more outputs from an input multiwavelength optical signal having an arbitrary state of polarization comprising:

a first polarization beam splitter combination receiving the input optical signal and providing two spaced apart, substantially parallel beam pairs, the beams of each pair being orthogonally polarized;

one or more stages of microoptic elements of non-birefringent characteristics, each receiving the beams from the first polarization beam splitter combination and configured with separate beam paths having selected differential optical retardation characteristics defining predetermined periodically spaced passbands, the outputs from the beam paths having selected polarizations;

a second polarization beam splitter combination receiving the outputs from the beam paths and combining differentially retarded beams from each of the two beam pairs to provide beams having wavelength dependent states of polarization; and

a third polarization beam splitter combination receiving the beams from the second polarization beam splitter combination and combining the beams to form first and second output beams including first and second intensity modulated output beams having transmissive passbands at selected periodically spaced channels, the channels alternating between the output beams.

Claim 49. (Original) An interleaver as set forth in claim 48 above, wherein the orthogonally polarized beams received by the non-birefringent microoptic elements are linearly polarized.

Claim 50. (Original) An interleaver as set forth in claim 49 above, wherein the beams in the non-birefringent optical elements in each path are similarly polarized, but beams in the separate paths are orthogonally related with the orthogonality relationship being reversed between successive stages.

Claim 51. (Original) An interleaver as set forth in claim 48 above, wherein the orthogonally polarized beams received by the non-birefringent microoptic elements are circularly polarized to reduce back reflection and ripple.

Claim 52. (Original) An interleaver as set forth in claim 51 above, wherein the beams in the non-birefringent elements in one path are similarly circularly polarized, while beams in the other path are oppositely circularly polarized.

Claim 53. (Original) An interleaver as set forth in claim 48 above, wherein the interleaver further includes first ¼ or ¾ waveplate means disposed in association with at least one of the stages for converting beams of linear polarization to circular polarization, and half waveplate means disposed in the path of the beams of circular polarization for varying the relative phase between the two beams propagating along parallel paths.

Claim 54. (Original) An interleaver as set forth in claim 53 above, wherein the half waveplate means comprises a pair of serially disposed angularly adjustable half waveplates, each separately intercepting a different differentially retarded pair of beams from the separate beam paths, and the interleaver further includes a second ¼ or ¾

waveplate means after the half wavelength means for restoring the circular polarizations to linear polarizations.

Claim 55. (Original) A signal interleaver in accordance with claim 48, wherein the microoptic elements of the stages comprise non-birefringent glass elements of at least two different glasses of different indices of refraction in each of the different optical paths, the indices and lengths of the glass elements being chosen to provide selected optical path lengths in each stage that are passively athermal over a selected temperature range.

Claim 56. (Original) A signal interleaver in accordance with claim 55 above, wherein the stages are arranged with optical path lengths and relative angles of polarization of the beams to the microoptic elements selected to flatten the periodically spaced passbands, and increase channel isolation between passbands.

Claim 57. (Original) A signal interleaver in accordance with claim 55 above, wherein the beams in the glass elements comprise upper and lower pairs and the interleaver further includes waveplates disposed in the upper and lower beam paths for matching optical path lengths to minimize PMD.

Claim 58. (Currently Amended) A compact optical interleaving filter component for a WDM input beam comprising:

an input fiber optic collimator directing the input beam into the component;

an input polarization beam splitter receiving the collimated beam and producing two orthogonally polarized beams traveling along parallel paths;

an input waveplate array to convert the two orthogonally polarized beams into two beams of identical polarization;

an intermediate polarization beam splitter receiving the beams from the ~~delay line elements~~ input waveplate array and configured to separate each of the two beams of identical polarization into a pair of orthogonally polarized beams;

at least two microoptic delay line stages having parallel optical delay line elements of nominal difference Δl and $2\Delta l$ in optical path length, the stages being disposed in series and separately differentially delaying the pairs of orthogonally polarized beams without using intrinsic material birefringence, the delay line stages including polarization rotating elements disposed at angles selected to adjust the optical frequency transmissive characteristic imparted to the two different beam pairs independently of the differential delays, and by separately rotating the polarizations of two pairs of the beams to selected angles;

an output polarization beam splitter after the final one of the stages to recombine each of the two beams of a pair into a single different combined output beam; and

output optics receiving the one or more output beams and including folding optics and output collimators arranged to direct the one or more output beams into the one or more output fiber optic collimators.

Claim 59. (Original) An interleaving optical filter in accordance with claim 58, wherein the input waveplate array is oriented to minimize PMD by balancing the optical path lengths traversed by the two beams.

Claim 60. (Original) An interleaving optical filter in accordance with claim 58, wherein the total optical length difference Δl is equal to 12 mm for a 25 GHz interleaver.

Claim 61. (Original) An interleaving optical filter in accordance with claim 58 wherein the total optical path length difference Δl is equal to 6 mm for a 50 GHz interleaver.

Claim 62. (Original) An interleaving optical filter in accordance with claim 58, wherein the total optical path length difference Δl is equal to 3 mm for a 100 GHz interleaver.

Claim 63. (Original) An interleaving optical filter in accordance with claim 58, wherein the total optical path length difference Δl is equal to 24 mm for a 12.5 GHz interleaver.

Claim 64. (Original) An interleaving optical filter in accordance with claim 58, wherein the polarization rotating elements are half waveplates which are disposed between the first and second interleaver stages at angles of -31.0 ± 1 degrees and between the second and third interleaver stages at angles of 13.1 ± 1 degrees.

Claim 65. (Currently Amended) A multistage optical signal interleaver for demultiplexing DWDM channels at a single beam terminal into odd and even output channels at second and third beam terminals or alternatively multiplexing odd and even input channels at the second and third terminals into a composite output beam at the first beam terminal comprising:

a first polarization beam splitter combination having a first terminal coupled to the single beam terminal and a pair of spaced apart beam terminals separate from the first terminal;

at least two stages of non-birefringent microoptic elements disposed serially along a beam delay path, each stage including separate beam paths having selected optical path length characteristics providing a chosen differential retardation between beams on the different paths, one serial terminus of the stages being in communication with the pair of terminals of the first polarization beam splitter, the other serial terminus providing a pair of beam ports;

an additional polarization beam splitter coupled optically between the pair of beam ports and the second and third terminals and

wherein each stage includes polarization beam splitter means arranged to direct at least two beam pairs through the stages, and each beam delay path includes a waveplate combination for phase tuning to selected channel placements.

Claim 66. (Cancelled)

Claim 67. (Currently Amended) An interleaver as set forth in claim [[66]] 65 above, wherein the non-birefringent optical elements comprise glass elements substantially of basic length L, and wherein channel spacing is defined by serial disposition in the stages of integer multiples of elements of the basic length and frequency period is adjusted by angling at least on polarization beam splitter.

Claim 68. (Currently Amended) An interleaver as set forth in claim [[64]] 65 above, wherein the stages comprise three stages of total lengths L, 2L and 2L for a 50 GHz interleaver, where [[n]] L is a length selected for a 100 GHz interleaver.

Claim 69. (Currently Amended) An interleaver as set forth in claim [[64]] 65 above, wherein the stages comprise two stages of nominal total lengths 2L and 4L for a 25 GHz interleaver, where [[n]] L is a length selected for a 100 GHz interleaver.

Claim 70. (Currently Amended) An interleaver as set forth in claim [[64]] 65 above, wherein the stages comprise two stages of nominal total lengths 4L and 8L for a 12.5 GHz interleaver, where [[n]] L is a length selected for a 100 GHz interleaver.

Claim 71. (Withdrawn)

Claim 72. (Withdrawn)

Claim 73. (Withdrawn)

Claim 74. (Withdrawn)

Claim 75. (Withdrawn)

Claim 76. (Withdrawn)

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Claim 100. (Withdrawn)

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Claim 102. (Withdrawn)

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Claim 109. (Withdrawn)

Claim 110. (Withdrawn)

Claim 111. (Withdrawn)

Claim 112. (Withdrawn)

Claim 113. (Withdrawn)